FORECASTING MENTAL HEALTH CARE COST FOR

OIF AND OEF VETERANS

THESIS

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AFIT/GCA/ENV/06J-01

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Abstract

The war in Iraq has been the longest sustained ground combat that the US military has engaged in since the Vietnam War. With the ongoing battle against the global war on terrorism, many military personnel will be deployed to hostile areas in support of these operations. The effects of multiple deployment and combat engagement on the mental health of military personnel have been extensively studied. The impacts of mental illnesses, such as PTSD, are tied to longer period in the combat zone. Meeting the psychiatric needs of these veterans will be costly: rehabilitation, retraining, postcombat counseling, long-term medical treatment, and even assisted living.

This study attempts to predict the cost of mental healthcare for the OIF and OEF veterans. However, we failed to accomplish a forecast for the cost of psychiatric treatment for those veteran populations due to data limitations. This study will not only give a general forecast for mental health care cost in the Veterans Affairs Healthcare System, but as well as explain any correlations between the various independent variables and mental health care costs.

The data were compiled from various government documents and medical journals. Information received from VA Office of Policy, Planning and Preparedness was extensively used in this study.

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CHAPTER 1

INTRODUCTION

1.0 Background:

   Much of the literature, journals, and previous research conducted after other military conflicts has shown that deployment and exposure to combat result in increased risk of posttraumatic stress disorder (PTSD), major depression, substance abuse, functional impairment in social and employment settings, and the increased use of health care services (Hoge et al., 2006:1023). Studies have shown that veterans with psychiatric problems use a significant amount of services from the Department of Veteran's Affairs (VA). Greater severity of mental illness increased the odds of both physical and mental health service use (Calhoun et al., 2002: 2081-2085).

   The history of mental trauma associated with war has been recorded as far back as the 12th century BC, as documented in Homer's Iliad. This Greek epic contains powerful descriptions of war trauma and stresses, such that soldiers frequently react with disappointed withdrawal, grief, and feelings of guilt towards fallen comrades (Shay, 1991:561). Handling human remains or killing an enemy combatant is also thought to be associated with mental problems (Mental Health Advisory Team, 2005:10). Bereavement might have some implications for depression and combat stress. Numerous accounts of combat reactions during World War II, Korean War, and after the Vietnam War have shown that extreme situations

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such as witnessing someone getting maimed or killed, are capable of causing abnormal behavior in people who had previously been completely normal. The underlying assumptions as suggested in the first Diagnostic and Statistical Manual (DSM I), are that every individual has a breaking point and that there are limits to the amount of stress that each person can tolerate (Lamprecht et al., 2002:224-228). DSM, now on its fourth edition, is a handbook published by the American Psychiatric Association used most often in diagnosing mental disorders.

The Defense Manpower Center has estimated that more than 438,000 troops have served in Operation Iraqi Freedom (OIF) since it was launched by the United States and its coalition partners (Howe, 2004:1). Fifteen to seventeen percent of service members who are surveyed 3-12 months post-deployment from OIF met the criteria for PTSD and other mental distress (Hoge, 2005:4). About 35% of OIF and OEF veterans used mental health services in the year after they returned overseas (Levin, 2006: 2).

The staggering numbers of OIF and OEF veterans with psychiatric illnesses are causing an influx of mental health care utilization within the Department of Defense (DoD) and VA health care system. The additional cost of providing benefits will become a major challenge for the government, especially now that an increasing number of veterans from previous conflicts are seeking compensation for psychiatric problems. Given the ongoing military operations in Iraq and Afghanistan, mental disorders are likely to remain an important health care concern for those who are serving there. President Bush's FY 2007 VA budget asks the Congress for a record

$80 billion, which includes $3.3 billion for mental health care, a $340 million increase over 2006 (Hoge et al., 2006:1031). It is expected that compensation and treatment of OIF and OEF veteran's mental health care may burden the already dwindling resources.

1.1 Research Objectives:

The main objective of this research is to forecast the growing cost of mental health care associated with the veterans coming back from Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). This study also investigates the correlation between several variables (such as the average length of inpatient hospitalization and number of veterans receiving treatment from various conflicts) with the utilization rate of mental health care within the DoD health care system.

1.2 Methodology:

The method used in this research is a first order multiple regression from 1980 to 2005. There are seven explanatory variables included in this model. In this study, the dependent variable (Y) being forecasted is the total cost of mental health care for veterans. The cumulative number of veterans seeking treatment from each conflict (WWII, Korean War, Vietnam War, Gulf War, and OIF/OEF), active duty end strength, and average length of inpatient hospitalization days are the independent variables. The general multiple regression method of this research follows the model below:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \ldots + e \quad (1)$$

where:

y = Total mental health care cost for OIF and OEF

$ß_i$ = **Determines the contribution of the independent variable**

$x_{1\ to}\ x_5$ = **Total number of veterans seeking psychiatric treatment from WWII, Korean War, Vietnam War, Gulf War, and OIF/OEF respectively.**

x_6 = **Total active duty end strength for the given year.**

x_7 = **Average length of inpatient psychiatric hospitalization.**

e = Error

$β$ represents the slope of the line relating y_i to $ß_i$ when all the other **x** variables are held fixed. The deterministic portion of the model which will be utilized to estimate the future values of total mental health cost from Fiscal Year (FY) 2006–2020 includes all the $ß_i$ coefficients.

The steps used to develop the multiple regression model is similar to those used for the simple linear regression model (McClave et al., 2005:768) except that in a time series regression, there are some additional problems that need to be addressed. The possible lack of independence in the residuals, a time-related effects such as trend, seasonality, or trading day variation, and a need to forecast first the explanatory variables to predict E(y) are some of the issues that have to be considered (Makridakis et al., 1998:263).

The National Institute of Health (NIH) Life Expectancy table from 1916 to 2003 was used to determine the mortality rate of psychiatric patients annually per conflict. It is imperative to calculate the number of patients who died each year in order to derive the cumulative number of mental health patient each year. The average days

of inpatient hospitalization from 1980 to1989 was derived by extrapolating data from the Bureau of Census. A more thorough discussion of the methodology will be explained later in this paper.

1.3 Scope and Limitations:

The insufficiency of data was the most limiting factor in this study. There were also inconsistencies with the actual figures reported from the various sources such as the Defense Manpower Statistics Center and Bureau of Census. Furthermore, the format of the reports changed frequently that some of the variables were omitted or aggregated. Data was normalized by taking the average if the actual numbers differ. The outcome of the study is limited to the general approximation of the future cost of treating mental health care for OIF veterans. The research might underestimate the total utilization of service for mental health and its associated costs due to minimal data. This research does not seek to ascertain the overall costs of medical expenditure associated with the war in Iraq. It is also worth mentioning that although objective measurement of total mental health care cost can be readily achieved using the regression method, the values used in the dependent variables to forecast total mental health care cost from 2006 to 2020 are just approximations based on the trend of the previous data. Furthermore, the annual expected death rate is based on the life expectancy of a normal and healthy individual, which may be different from a person suffering from a certain form of mental illness. The data used in this research is very limited to discerning the differences of life expectancies of individuals suffering from a specific psychiatric problem.

CHAPTER 2

LITERATURE REVIEW

2.0 The Psychological Effects of War in Iraq

The negative mental health consequences of war-zone exposure are well established. Findings indicate that stressful and traumatic deployment experiences are associated with a variety of negative mental health consequences such as depression, anxiety, post traumatic stress disorder (PTSD), and even suicide (Vogt et al., 2005:115). Since the operation in Iraq has officially started on 19 March 2003, more than 341,000 active duty troops have served two or more overseas tours (Bennis et al., 2005: 7). A report prepared by the staff of the US Central Command, Combined Forces Air Component Commander, indicated that as of 30 April 2003, there were 466,985 total personnel deployed for Operation Iraqi Freedom (OIF). This includes US Air Force (USAF), 54,995; USAF Reserve (USAFR), 2,084; USAF National Guard (USAFNG), 7,207; US Marine Corps (USMC) 74,405; USMC Reserve (USMCR), 9,501; US Navy (USN), 61,296 (of which 681 are US Coast Guard); USN Reserve (USNR), 2,056; US Army (USA), 233,342; USA Reserve (USAR), 10,683; and USA National Guard (USANG), 8,866 (Carter, 2005:2).

With the increasing need for a military presence in Iraq and a conflict with no clear end in sight, many of these deployed troops are exposed to mental stressors. Injuries and death, active fighting, environmental stressors such as extreme cold or hot weather and fatigue are some of the factors that may exacerbate the psychological trauma inflicted upon deployed US troops. For example, 769 military

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personnel deployed in Iraq were medically evacuated in 2003 due to psychiatric reasons (Harman et al., 2005:525). Studies have indicated that troops who served in Iraq are suffering from PTSD and other problems on a scale not seen since the Vietnam War. According to Walter Reed Medical Center Army Institute of Research, 19% to 21% of troops who have returned from combat deployments meet criteria for PTSD, depression, or anxiety. Of these, 15% to 17% of troops who served in Iraq and 6% of those who served in Afghanistan had symptoms of mental health problems when surveyed three to twelve months after their deployments. In general, PTSD rates were highest among units that served deployments of 12 months or more and had a greater exposure to combat (Kaplan, 2006:2). Furthermore, almost 82% of the medical evacuations during OIF were due to psychiatric reasons (Stetz et al., 2005:17), a larger percentage compared to the estimated 15% during the Vietnam War (Irving et al., 1997:1).

OIF is dramatically different compared to the previous major battles that the US Armed Forces have engaged. Urban combat mixed with prolonged deployments of combat forces (Robinson, 2004:2), unconventional warfare with enemies using roadside bombs, suicide bombers, and undistinguishable enemies (i.e. man, woman, or a child) creates an extremely stressful situation (Vhalos, 2004:2)

Medical surveillance data obtained from the Army's Center for Health Promotion and Preventive Medicine on health assessment responses, completed between January and August of last year, shows that safety is the highest concern for individuals deployed to Iraq. Following safety are concerns about hypervigilance,

nightmares, and depression or hopelessness, all of which are indicators of PTSD (see Figure 1). Just being deployed to Iraq can cause chronic stress especially for those who are at a higher risk of being involved in a combat situation, such as US military members patrolling the streets (Vedantam, 2006:2). The number of US deaths in Iraq supports the findings of the health assessment. The Directorate for Information Operations reported that there were 382 US casualties during the Persian Gulf War, from 1990-1991 compared to 2,431 for OIF, from 19 Mar 2003 to 10 May 2006. Dr. Mark Brown, director of Environmental Agents Service at the VA, stated that for every military member who gets killed, there are a half-dozen or more present. Such experiences may have an overwhelmingly detrimental effect on the mental health of those present (Howe, 2004).
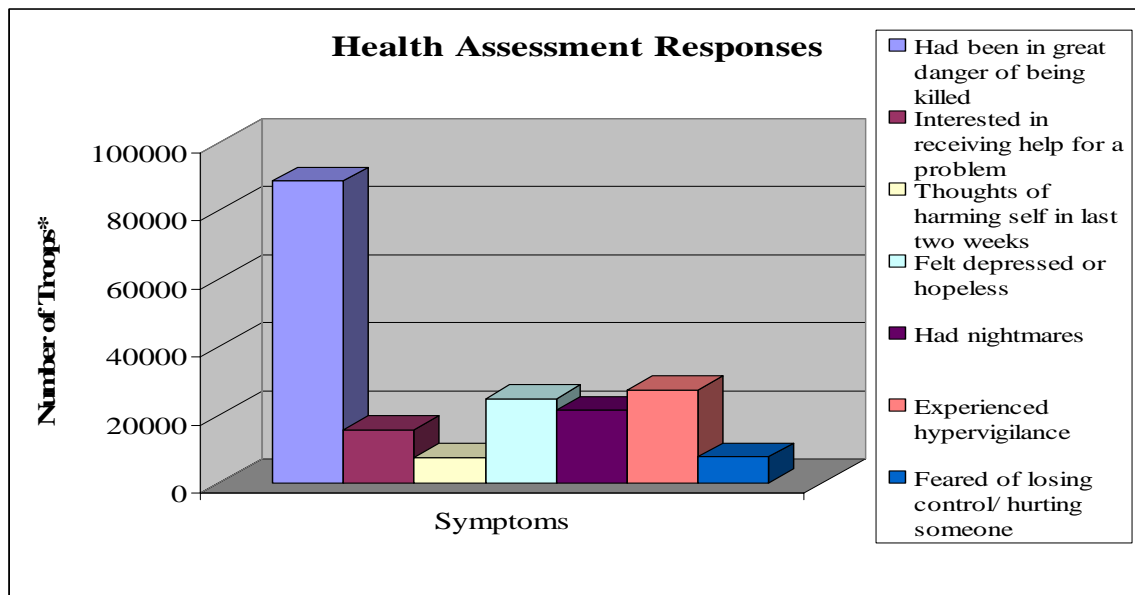

Figure 1. Health Promotion and Preventive Medicine Surveillance Data 2005
Source: U.S. Army's Center for Health Promotion and Preventive Medicine
* Total number of troops assessed= 193,131.

Post-traumatic stress disorder is a condition where a traumatic event outside the range of the usual human experience such as a serious threat to one's life or physical integrity, is persistently re-experienced in dreams, nightmares, flashbacks, or recurrent and intrusive distressing recollections of the episode, which can be triggered by an exposure to an event that symbolizes or resembles an aspect of that traumatic experience (Burkett et al., 1998:158-159). The person suffering from PTSD commonly makes a deliberate effort to avoid thoughts, feelings, conversations about the traumatic event, activities, situations, and people who arouse recollections of the event.

This avoidance of reminders may include amnesia for an important aspect of the traumatic event. Diminished responsiveness to the external world, referred to as "psychic numbing" or "emotional anesthesia", usually begins soon after the traumatic event. The individual may complain of having a markedly diminished interest or participation in previously enjoyed activities and feelings of detachment to other people. This person may have a sense of a foreshortened future, for example, not expecting to have a career, marriage, children, or a normal life span (First et al., 2000:464-469). PTSD is marked by clear biological changes as well as psychological symptoms. This anxiety disorder is complicated by the fact that it frequently occurs in conjunction with related disorders such as depression, substance abuse, problems of memory and cognition, and other problems of physical and mental health. The disorder is also associated with impairment of the person's ability to function in

family life, including occupational instability, marital problems and divorces, family discord, and difficulties in parenting (Ford et al., 2006:2).

War-zone stressors can compromise the psychological resilience of even the most conditioned service members, thus leading to psychiatric casualties during war (Stetz et al., 2005:18). Although the majority of mental health care providers focus on the effects of PTSD, there are a myriad of other negative mental health consequences caused by war zone exposure and other deployments. Many aspects of the experience have been well-studied, including its effects on substance use and anger management.

Military members who are deployed to Iraq that suffer from symptoms of PTSD are likely to have difficulties with anger regulation given the centrality of anger in the human survival response. Research among military veterans has consistently shown that those with PTSD demonstrate more anger, hostility, aggression, general violence, relationship violence and abuse than those without the disorder. Rage and irritability are prevalent emotions in PTSD (Reyes, 2005:483) and can have a debilitating impact across several domains including, social and occupational functioning. These interpersonal difficulties may have a profound negative effect on the veteran's social support network, which places them at risk for PTSD exacerbation, and possibly for cardiovascular disease and other health problems that have been associated with anger and hostility (Schnurr et. al. 2004:70).

Substance use is of concern in both deployed and nondeployed settings because it can have adverse results on the military person's health and social life.

Furthermore, it can have detrimental effects on military readiness and on the safety of personnel during deployment. If increases in substance use are associated with deployment, this relationship can have long-term implications for alcoholism, illicit drug use, and excessive smoking among military personnel. A number of factors related to deployment may influence patterns of substance use, including changes in social support, perceptions and experiences of stress, access to substances, normative attitudes regarding substance use, and supervision (Federman et al., 2000: 206).

The 2002 DoD Survey of Health Related Behaviors Among Military Personnel has shown that both illicit drug and cigarette use declined significantly between 1980 and 2002. However, the rates of heavy alcohol use did not show a significant decline between those periods (from 20.8% to 18.1%), indicating that more than one out of six military personnel in 2002 was likely to be a heavy drinker (Bray et. al., 2003:74-76).

A different study conducted in 1994 comparing drug and alcohol service utilization rates found higher rates of substance use among US Army units deployed during the Persian Gulf War versus units that were not deployed (Rothberg et. al., 1994:246-248). Labbate and Snow (1992) supported these studies between substance use and military deployments with their findings about an Army unit which reported using alcohol to alleviate nightmares or to aid sleep.

Anger is a common emotion for a majority of military members treated for depression, adjustment disorders with depressed mood, combat stress anxiety, and occupational problems. Research involving combat veterans has shown that anger

and rage are prevalent emotions in post-traumatic stress disorder. Anger is mediated by the fight-or-flight response, which motivates military personnel to complete their missions. When it becomes uncontrolled, however, military personnel become a danger to themselves or others, reducing combat readiness and effectiveness and the morale of the unit. Angry, dangerous military members raise serious concerns for the safety of other military individuals, because of the accessibility of numerous weapons in the combat zone (Reyes, 2005:483-484).

The psychological effects of war are many and hundreds of studies have been conducted in this area. It is widely recognized that exposure to combat and other wartime experiences can have both short-term and long-term psychological effects. PTSD has been the focus of many of these studies because of its varied effects. The comorbidity of PTSD with other mental disorder such as depression, alcoholism, anxiety, sadness, drug abuse, and suicidal tendencies requires more resources for the treatment. Specialized behavioral health services might increase the actual spending for treatment of mental illness for the veterans.

2.1 The Mental Health Care Cost of Operation Iraqi Freedom:

2.1.1 Costs of Psychiatric Treatment:

Treatment for mental disorders rests essentially on two main approaches, pharmacotherapy and psychosocial rehabilitation (including psychotherapy). The VA, just like the various active duty medical treatment facilities (MTF's), targets populations that needed special emphasis, such as those suffering from a serious mental illness, post-traumatic disorder, and substance abuse. Preliminary data

prepared for the FY 2000 Capacity Report on seriously mentally ill (SMI) veterans identify $1.9 billion spent treating 290,819 SMI veterans at a cost of $6,551 per veteran (Garthwaite, 2000:2-4). However, in a separate study, it was found that spending for specialized inpatient mental health care fell 21 percent from 1995 to 1998 even though the spending for specialized outpatient care rose 63 percent. Coupled this with a rapid increase in outpatient pharmacy expenditures (Chen et al., 2003) and the stage is set for increasing mental health care costs going forward.

A further study in predicting costs of VA health care for Gulf War veterans found that as many as 37% seeking evaluation for medically unexplained physical symptoms (MUPS) suffer from mental disorder, typically PTSD and depression. MUPS has been associated with extensive and costly use of health care resources accounting for nearly 60% of annual ambulatory care visits in the U.S. (McFall, 2005:70).

Marshall and his colleagues found that PTSD was associated with a 60% increase of medical utilization by patients often not for psychiatric complaints but instead physical problems. In particular, several studies have associated PTSD with greater concomitant prevalence of medical morbidity including: respiratory, cardiovascular, neurological, and musculoskeletal disorders, as well as additional psychiatric comorbidity. The end cost may be difficult to measure in dollars, but is obviously very costly in the quality of life (Baxter, 2004:147-148).

Using a series of least squares regression analyses, a study conducted on predicting costs of VA's health care in gulf war veterans with medically unexplained

symptoms showed that the specific measures of PTSD, depression, and mental global health functioning (GMHF) were statistically significant at the 99% confidence interval (p< 0.005) in predicting the increased outpatient mental health costs (McFall, 2005:71-72). Therefore, many of the hospitalizations for physical illnesses may have been psychosomatic in its etiology.

Hoge and his colleagues concluded with their research that combat duty in Iraq was associated with high utilization of mental health services and attrition from military service after deployment (Hoge et. al., 2006:1029-1031). The cost of mental health problems are high and are borne by many parties other than the individual patient. Costs include the loss of time at work due to visits to health care providers and days of missed work, as well as days during which the worker's performance is impaired due to the mental health problems associated with their the beneficiary (Constantian, 1997:2).

Below (see Figure 2) is a comparison between the actual expenditures for inpatient psychiatric treatment and the obligated expenditures from 1992 to 2002. It is noteworthy that between 1995 and 1998, the actual expenditure decreased relative to the appropriated funds for psychiatric treatment. This decrease in expenditures can be attributed to the closure of 9,893 mental health inpatient beds as the VA made cost-cutting changes in the delivery of inpatient psychiatric care (Rosenheck et al., 2001:169). The rate difference between 1998 and 2001 is stable for both of the variables, but there is an upward trend starting in 2002. With the increasing number of OIF and OEF veterans suffering from psychiatric illnesses, the actual expenditure

for treating psychiatric illness might surpass the appropriated funds for long periods of time.

Comparison of Total Expenditures and Obligations for Inpatient Psychiatric Treatment
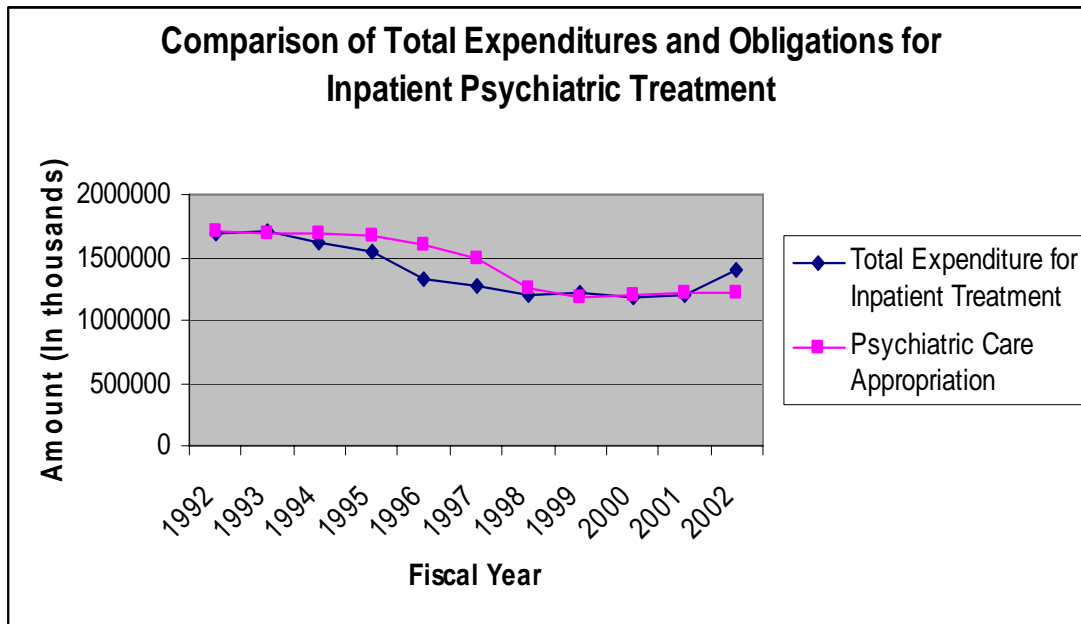
Figure 2. Expenditures and Obligations for Inpatient Psychiatric Treatment Sources: Congressional Budget Office; VA Administration Report (September 2002)

2.1.2 VA Compensation for Psychiatric Problems:

The diagnosis and treatment of mental disorders are critical not only for the troops, veterans, and their families but also for the government. The cost to the nation of caring for troops returning from Iraq with disabling mental health conditions may increase in the future. If a 24-year-old married military member with one child develops PTSD to the degree of being unemployed, then that individual could receive compensation payments from the VA of over $2,400 per month for the remainder of his life. Over an average male lifespan, such costs could amount to more than $1.3 million, not including inflation (Robinson, 2004:5). With the tens of thousands of US soldiers diagnosed with PTSD and related problems since the US-

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led invasion of Iraq in 2003 (Greene, 2006), the cost of disability compensation for these veterans could be enormous (see Figure 3 for monthly compensation which includes special monthly compensation, allowance to dependents, unemployables receiving compensation at the 100% rate, and other awards).
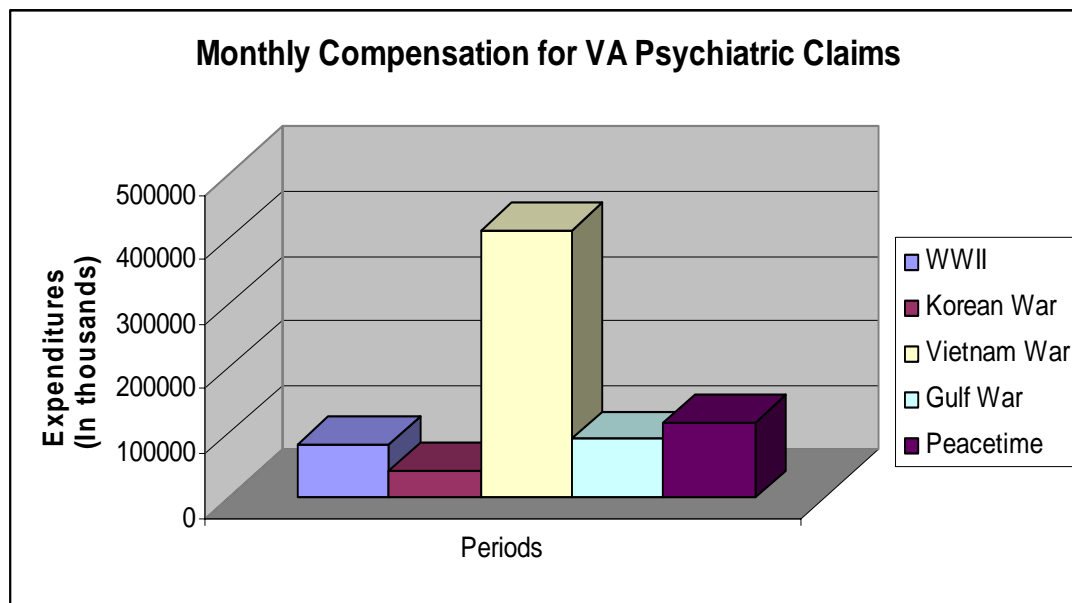
Figure 3. Monthly Compensation for Psychiatric Claims (2005)
Source: VA Administration Report, RCS 20-0223 (September 2005).

Currently, there are more than half a million individuals in the VA system that is receiving compensation due to mental illness, 20 percent of the total population receiving disability payments. It is discernible from Table 1 that veterans who are 70 to 100 percent mentally impaired make up the highest expenditure. A review from a DoD Inspector General report found that the number of 100 percent PTSD ratings granted to veterans varied widely among regions in the nation. This prompted a review of over 72,000 PTSD individual claims and possible cuts. The total monthly payment for veterans who are 100 percent mentally disable almost constitute 50 percent of the total disability payment for mentally handicapped veterans.

**Table 1. Number of Veterans who Received Compensation for Mental Illness
and Monthly Values Based on the Degree of Impairment (2005)**

Degree of Impairment	Number	Monthly Value
Total -- all periods	536,449	$ 745,950,300
Zero Percent (statutory award)	0	0
10 Percent	70,360	7,614,800
20 Percent	19,814	4,169,300
30 Percent	56,306	19,907,000
40 Percent	36,358	18,731,600
50 Percent	45,328	32,659,400
60 Percent	37,725	41,555,200
70 Percent	72,968	143,668,500
80 Percent	42,873	90,840,700
90 Percent	21,265	48,132,800
100 Percent	133,452	338,671,200

Source: VA Office of Policy and Planning and Preparedness -008A3 (2005)

Figure 4 below shows the total obligated expenditures for the VA from 1971 to 1995. It is interesting that compensation and disability payments (C&P) have a positive linear relationship starting from 1975, except from 1986 to1995. Medical expenses during these periods have risen dramatically faster than C&P, while the all category expenses (which includes construction and operating expenses) has continued to decrease. It can be assumed that C&P and medical expenditures have definitely affected with each other.

The majority of the veterans who are receiving psychiatric disability payments are from the Vietnam War, followed by the Gulf War, peacetime veterans, WWII and Korean War (see Figure 5). Veterans from the earliest conflicts are decreasing in numbers due to death. This table does not include OIF/OEF veterans who are increasingly seeking disability compensation payments for PTSD and other forms of psychiatric problems.

PERCENT OF TOTAL OBLIGATED VA EXPENDITURES
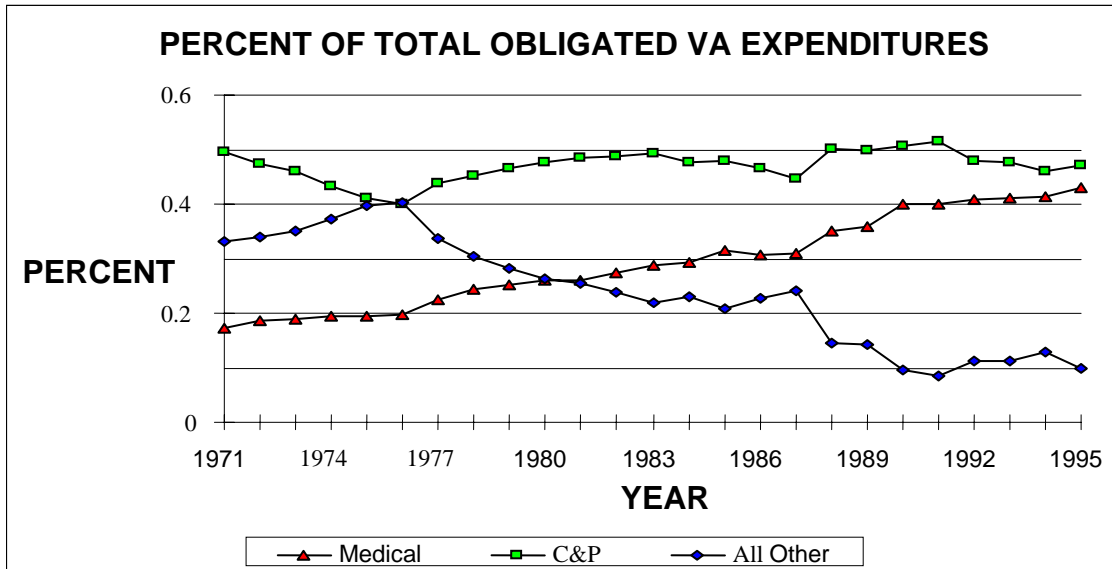
**Figure 4. Percent of Total Expenditures of Veterans Affairs from 1971 to 1995
Source: DVA System Wide Obligations, Resource Formulation Office**

Number of Veterans Receiving Compensation for Psychiatric Treatment
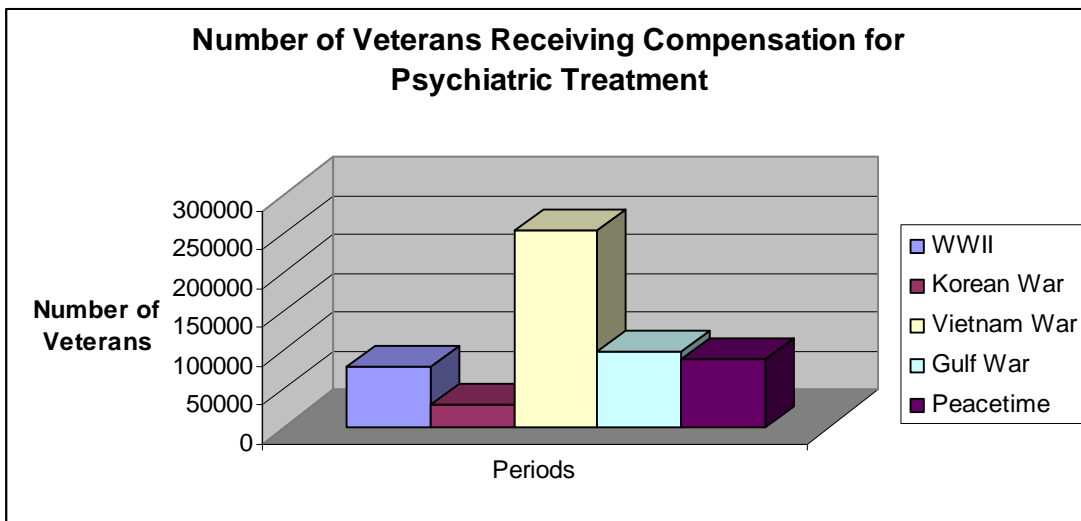
**Figure 5. Veterans Currently Receiving Compensation for Psychiatric Problems
Source: VA Administration Report, RCS 20-0223 (September 2005).**

2.1.3Rate of Suicides:

The alarming rate of suicides witnessed earlier this year among US troops serving in Iraq has raised a red flag about the mental strain on our service men and women. These suicides are the most visible manifestation of the rising mental health

toll from the war in Iraq and other U.S. combat operations abroad (Robinson, 2004:1). According to the Army Medical Mental Health Advisory Team (MHAT) in Iraq, there have been a total of 21 soldiers who committed suicide in the theatre, while 67 more killed themselves after returning from their deployment (Howe, 2004:2). The Air Force has not reported any suicides as of October 19, 2005, but the rate of suicides in the Army between January and October of 2003 represent an annualized rate of 12.5 suicides per 100,000 soldiers. The Army suicide rate for the eight year period 1995-2002 averaged 11.9 per 100,000 and range from a low of 9.1 in 2001 to a high of 14.8 in 1995. However, the OIF suicide rate has been 15.6 per 100,000 per year, considerably higher than the average annual rate (OIF MHAT, 2003).

Veterans groups and media accounts have claimed that most suicides occur after troops return home from deployment. One highly publicized case was that of a Marine reservist, Jeffrey Lucey, who was diagnosed both with PTSD and depression, coupled with psychotic episodes, suicidal tendencies, and acute alcohol intoxication. A note was found in his bed the day he hanged himself stating that he was forced to shoot two unarmed Iraqi prisoners. Furthermore, three men who had served with the Army's 10th Special Forces in Iraq committed suicide shortly after returning home (Kaplan, 2006:1-3). Looking at Figure 6 below, the overall suicide rate has been dropping in the past ten years for all military branches, however; this data period excludes much of OIF and OEF. Based on the discussion earlier, we can only assume that during the global war of terrorism (GWOT) and the accompanying high

operations tempo, many more military members will be exposed to stressors possibly leading to suicidal tendencies in more American troops. A review of current information on suicide in the Army has found that among individuals dependent on alcohol, suicide vulnerability is related to the severity and duration of alcoholism, social isolation, and concurrent depression (Allen, 2005:580).
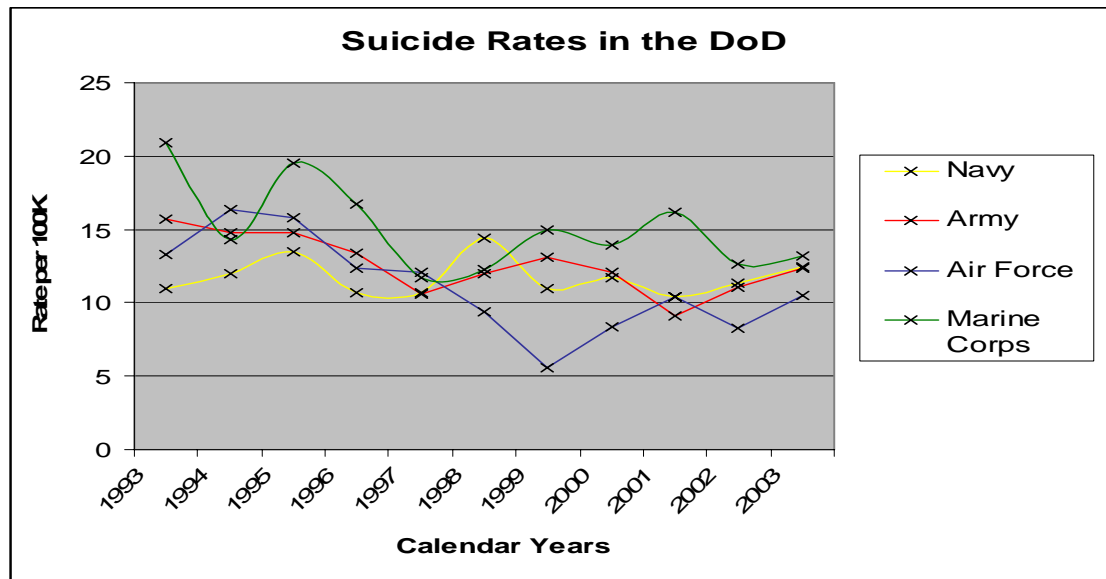
Figure 6: Department of Defense Suicide Rate from 1993 to 2003
Source: Military Medicine, Volume 170 (July 2005)

The cost of lives lost due to suicide is deleterious to the Armed Forces. The U.S. Department of Defense (DoD) strength rests with its active duty military personnel, augmented by a group of professionals who are ready to serve on Active Duty, as needed by the current situation. Suicide is detrimental to the readiness of the Armed Forces and is a personal tragedy for all those affected. To further illustrate the cost of suicide in the military, during the 1990's, the Army lost the equivalent of an entire battalion from suicides (about 803 soldiers). This ranks as the third leading cause of death for soldiers, exceeded only by accidents and illnesses. Even more

startling is that during this same period, five times as many soldiers killed themselves than were killed by hostile fire (OIF MHAT, 2003). Although military mental health care professionals and senior leaderships are actively pursuing ways to eliminate or reduce suicide among OIF veterans, statistics show that suicide is rising among the military members coming back from OIF and OEF.

With no end in sight to a substantial US presence in Iraq, the number of nonfatal casualties, currently more than eight per day, is likely to keep increasing. Beyond the human dimension, the cost of such casualties, which tend to be overlooked as part of the cost of national security and foreign policy, will also continue for decades. Among these costs: rehabilitation, retraining, postcombat counseling, long-term medical treatment, assisted living care, and suicides (Knickerbocker, 2003:1).

The operation in Iraq has been the longest sustained ground battle since the Vietnam conflict. As the US continues to fight against terrorism, many more troops will be deployed to hostile areas, such as Iraq and Afghanistan. The VA and DoD Healthcare System must be ready for the cost associated with medical care, especially mental health care for these veterans.

CHAPTER 3

METHODOLOGY

3.0 Procedures for Regression Model with Time Series:

The steps used to develop a multiple regression model are similar to those used for the simple linear regression model. In the context of regression, the researcher often wishes to draw a curve that in some sense fits the data as much as possible. There are at least two objectives in fitting a curve:

- General Study: Conducted when the researcher is interested in discovering any general relationships between the independent variables, X_K, and the dependent variable, Y.

- Prediction: The researcher may be interested in determining the relationship between X_K and Y, in order to be able to predict Y for a given value of X_K.

There are also various assumptions that have to be made about the distribution of the error term:

- The mean of the probability distribution of ε is 0.

- There is a constant variance of the probability distribution of ε.

- There is a normal distribution of ε.

- The random errors are independent.

All of these assumptions will be discussed further. In this study, the main objective is to predict the cost of mental health care for veterans coming back from

OIF and OEF. Below are the various steps involved to form the foundation of building the regression model for this research:

1. The first step is to hypothesize the deterministic component of the model.

In any regression model, the explanatory variables $X_1, X_2,...,X_i$, take values which are assumed to be either fixed or random but they are uncorrelated (Makridakis et al., 248:1998). This component relates the expected value of the dependent variable, $E_{(Y)}$, to the independent variables, X_K, and involves the choice of independent variables to be included (McClave et al., 769:2005). Much of the literatures, including several medical journals were utilized to determine possible significant X_K variables, such as the average length of in-patient psychiatric treatment. However, as is seen by Table 2, only seven independent variables were considered due to data availability.

Table 2. Regression Coefficients

Variables	Stata Input
Total Psychiatric Treatment Cost	COST
WW II Veterans Psychiatric Patients	WWII
Korean War Veterans Psychiatric Patients	KW
Vietnam War Veterans Psychiatric Patients	VW
Gulf War Veterans Psychiatric Patients	GW
OIF/OEF Veterans Psychiatric Patients	OIF
Average Length of Stay in the Hospital (days)	Length
Active Duty DoD End Strength	ENDSTR

Heteroskedascity occurs when the errors do not have a constant variance across an entire range of values. A well-fitted regression model should have a homogenous variance of the residuals. To check how the residuals are distributed, a Breusch-

Pagan test and White Tests were conducted for heteroskedascity. Both methods test the null hypothesis, H_O, for homogeneity on the variance of the residuals (Stata Regression Handbook, 2005:2:17-40). The strength of the White Test is its lack of sensitivity to outliers, as compared to the Breusch-Pagan test.

Using ordinary least square regression techniques on time series data potentially introduces additional problem that needs to be addressed. A possible lack of independence in the residuals has to be examined. The most common method for checking such autocorrelation is the Durbin-Watson test. This statistic is calculated from the residuals of the regression and is used to test for first-order autocorrelation. First-autocorrelation occurs when the disturbance in one time period is a proportion of the disturbance in the previous time period (Kennedy, 2003:140-142). If first-order autocorrelation is detected, one way to correct for this is to include an autoregressive term either with or without differencing. This technique is more commonly referred to as the Auto Regressive Integrated Moving Average (ARIMA) or more popularly known as the Box-Jenkins model.

Many regression models assume a normal distribution for the error term. This makes no difference to the estimates of the coefficients, or the ability of the model to accurately forecast the variables of interest (Mickey et al., 2004:272). However, it does affect the F- and t-tests, as well as the confidence interval. We are not concerned about violating the normality of the residuals in this research since hypothesis testing will not be included in the methodology.

2. The second step is estimating the parameters using the sample data.

There are only twenty-five observations in our data from 1981 to 2005, which we include in the OLS regression. The estimator generating the set of values of the parameters that minimizes the sum of squared residuals is called the ordinary least squares estimator (Kennedy, 2003: 18). That is, the chosen estimated model is:

$$Y_{HAT} = \beta_{0\ (HAT)} + \beta_{1\ (HAT)} X_1 + \beta_{2\ (HAT)} X_2 + \beta_{3\ (HAT)}\ X_3 + \ldots + \beta_{K\ (HAT)}\ X_K \qquad (2)$$

This minimizes the Sum of Squared Errors (SSE). The values of the coefficients are easily estimated. The primary difference between fitting the simple and multiple regression models is computational difficulty (McClave et al., 2005:770). However, if the model requires an autoregressive specification, the estimation becomes more difficult. As such, we will attempt the simplest step first, attempting to use the OLS. Only evidence of serial correlation among the residuals will cause us to use the ARIMA specification.

3. The third step is to check that all the assumptions about the residuals are satisfied.

The residuals were plotted against the fitted values to check for independence with Y_{HAT}. The residuals are assumed to have a normal probability distribution with mean equal to 0 and the variance equal to s^2. The variance plays a major role in making inferences about β_K in estimating Y_{HAT}. Model modifications can also be made during this stage. This is the step where we will run the Breusch-Pagan test for serial correlation.

4. Evaluation of the usefulness of the model.

The usefulness of the model can be statistically evaluated easily by detecting specification errors. A model specification error can occur when one or more relevant variables are omitted in the model or irrelevant variables are included. Model specification errors can substantially affect the estimate of regression coefficients. The robustness of the model can also be measured by the R-squared value, as reported on the analysis of variance (ANOVA) table. The formula for R-squared is given below

$$R^2 = 1 - \frac{SS_{error}}{SS_{total}}$$

(3)

5. Using the model for estimation and prediction.

After all of the assumptions are met, then the regression model can be utilized for forecasting purposes**.** This research will utilized an OLS with an AR (1) model to account for serial correlation. This indicates that a one-period lag of the dependent variable will enter into the forecast. Absent data limitations, a true out-of-sample test using a hold out set is the best way to assess the model's accuracy. Unfortunately, there are zero values from 1981 to 2002 for OIF. Attempting to estimate an in-sample and out-of-sample dataset causes a near singular matrix in the maximum likelihood estimator. Therefore it is not feasible to do an out-of sample test.

3.1 Assumptions:

There are several assumptions that have to be made in order to build the regression model. These assumptions were based on some medical journals,

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literatures, and other sources that support the study. The following are the assumptions made:.

1. The time span for the regressors is inclusive from 1980 to 2005 only, although the dataset includes an estimate of the number of veterans who have previously separated, since the end of each conflict.

2. The number of new psychiatric patient is based on the number of veterans from each specific conflict who separated from the service, multiplied by certain factors. About 33% WW II veterans (Lee et al., 1995:516-522), 30% of Korean War veterans (Mellman et al., 1991:1568-1574), 31% of Vietnam War veterans (Kaplan, 2006:1) (Irving et al.,465), 31% Gulf War Veterans (McFall et al., 2005:70), and 17% of OIF/OEF Hoge et al., (2004) and Kaplan (2006), veterans separating from the active duty force will seek psychiatric treatment.

3. Numbers of anticipated OIF/OEF veterans that will seek psychiatric treatment after 2005 will be equal to the number of post Gulf War veterans multiplied by the factor rate of 30%.

4. It is assumed that there will still be new psychiatric patients from OIF and OEF entering the VA Medical Health Care System until 2020. There has been no definite time table for withdrawal of troops in Iraq especially with continued guerilla warfare and instability. It can be assumed that there will be a longer military US presence in Iraq.

5. PTSD is comorbid with various psychiatric illnesses. The above factor rates mentioned earlier also includes other mental health problems as well.

6. The cumulative number of patients each year (i.e. WW II, Korean War, and Gulf War) is calculated based on the detailed life expectancy table, both for male and female, and for all races, from the National Institute of Health. The total number of psychiatric patients per year is based on the number of new patients combined with the number of surviving veterans from the previous years

3.2 Data Base:

The majority of the data gathered for this research came from various government databases, such as reports from the VA. There were also other sources such as medical journals and other literature that provided information for the research. Below is a list of some the data sources for this research:

- Statistical Abstracts from 1951-1994, US Census Bureau
  - Tables from National Defense of Veterans Affairs, Number of Patient Receiving Healthcare Authorized by the VA
  - http://www.census.gov/prod/ww/abb/statab1951-1994.htm
- Department of Veterans Affairs-Healthcare Trend Data
  - Table 31: Average Number of Operating Beds by Type VA Medical Centers and Hospital Care Component.
  - Table 33: Admission to the VA and Non-VA Hospitals In-Patient Care

- Veterans Population Estimate Until 2030; Table S1- Separations of Military Members by Period of Service

- Population Representation in the Military Services Appendix A thru E

  - http://www.dod.mil/prhome/poprep2002

- Review of State Variances in VA Disability Payments and Compensation, DVA Office of Inspector General

  - http://www.va.gov/oig/52/reports/2005/vaoig-05.00765-137.p

- CRS Report for Congress (Received through the CRS Web)

  - Iraq Summary of US Casualties, Order Code RS25178

CHAPTER 4

ANALYSIS

4.0 Model Form:

 After doing the Ordinary Least Squares Regression, it produced the following coefficients:

Table 3. First Least Square Regression Estimation

Variables	Coefficients	p-values
Constant (1)	6,800,000,000	0.0019
WW II	-142.3165	0.5785
KW	20,220.05	0.1262
VW	-2,679.162	0.0226
GW	-1,379.37	0.3492
OIF	14,379.23	0.3394
LENGTH	-5,768,446	0.3991

 The R-Squared for this regression was 0.637536, while the adjusted r-squared is 0.509607. The constant and the variable VW are statistically significant. However, the value of the Durbin-Watson statistic causes some concerns. A value of 0.853570 for the Durbin-Watson statistic indicates that there might be an evidence of serial correlation in the residuals. To test for the significance of the Durbin-Watson value, it is imperative to examine its distribution using the DW table.

Table 4. Durbin-Watson Interval

Number	Interval	Interpretations
1	Less than DW_L	Autocorrelated
2	Between DW_L and DW_U	Inconclusive
3	Between DW_U and 4- DW_U	No Autocorrelation
4	Between 4- DW_U and 4- DW_L	Inconclusive
5	More than 4- DW_L	Autocorrelated

The Durbin-Watson test is based on the five regions as indicated in Table 4above and demonstrated in Figure 7 below. The actual distribution of the *d* statistic can be shown to lie between two limiting variables which critical values have been tabulated. The interval can be calculated by locating the lower bound (DW_L) and upper bound (DW_U) values through the number of observations, *n*, in the column and parameters, *k -1*, in the row. Checking the DW statistical table for a 5% one-sided test, with *k* = 5 and *n* = 25, DW_L and DW_U values are 0.95 and 1.89 respectively (Makridakis et al., 1998:303-304). This indicates that the calculated *d* statistics suggests autocorrelation. Serial correlation happens when the residuals associated with one observation are affected by residuals of other variables.
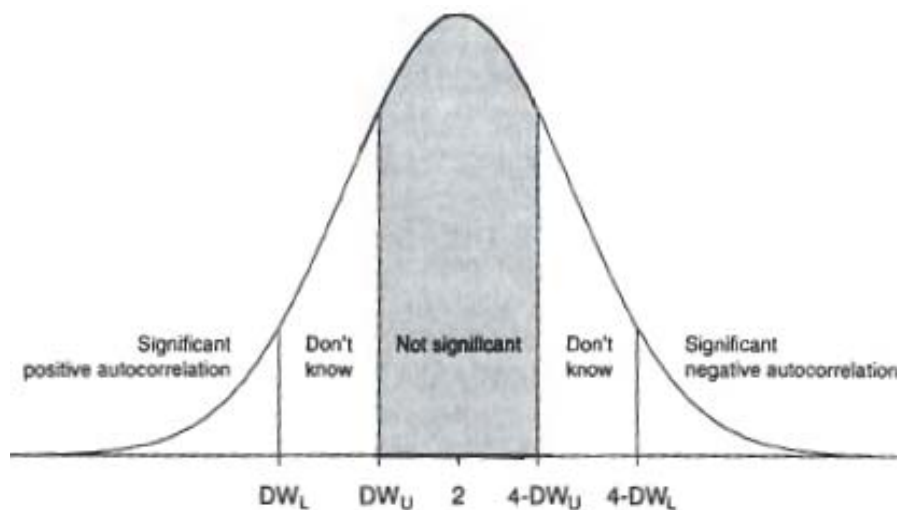
Figure 7. Durbin Watson Distribution
Recreated from the 3rd ED of Forecasting, Methods and Methodology text.

To avoid the problem of lack of independence in the residuals, the variables are lagged one period. Table 5 shows the result of the regression including the autoregressive part. The Durbin-Watson test has significantly improved with a value of 1.339240. Referencing Table 5 and Figure 8, the value from the DW test is

located in the "not significant" area of the distribution indicating that there is no serial correlation within the regression.

Table 5. Least Square Regression Estimation with AR Component

Variables	Coefficients	p-values
Constant (1)	8,230,000,000	0.0081
WW II	3,789.154	0.1626
KW	12,044.38	0.4006
VW	-3,538.202	0.0267
GW	1,197.321	0.5799
OIF	-670.6142	0.962
LENGTH	-1,540,915	0.771
AR (1)	0.303036	0.0001

Furthermore, the R-squared with a value of 0.778 and Adjusted R-squared of 0.674 has also increased. This demonstrates that almost 67% of the total forecasted cost for mental health care treatment for veterans in the VA can be predicted by the variables included in the model. The adjusted R-square statistics yields a more accurate estimate of the percent explained than does the R-squared value. The constant, AR, and VW variables are all statistically significant variables, at least at the 95% confidence level. It is worth mentioning that the Akaike Information criterion has dropped from 40.19 to 39.83 indicating that the first model has a better goodness-of-fit test. However, the difference is very small, such that the discrepancies between the observed and the forecasted values of both models will be insignificant.

A Breush-Godfrey serial correlation test was also conducted. It tests the null hypothesis that there is no autocorrelation existing in the model. The test with a p-

value = 0.271 failed to reject the null hypothesis suggesting that the residuals are independent from each other. Based on the post-estimation tests, the model with an AR (1) term will be utilized. The generalized model will be:

$$Y_{HAT} = 8, 230, 000, 000 + 3789.154 \ X_1 + 12044.38 \ X_2 - 3538.202 \ X_3 + 1197.321 \ X_4$$

$$- 670.6142 \ X_5 - 1540915 \ X_6 + AR \tag{4}$$

4.1 Simulating the Forecasted Values:

Using the generalized model above and accounting for the AR term, the total forecasted values for mental health care treatment for FY 2006 to FY 2020 is presented in Table 6:

Table 6. Forecasted Values for Overall Expenditures

Year	Total Forecast
2006	1638886586
2007	1760970383
2008	1773952834
2009	1746782698
2010	1761820406
2011	1762346459
2012	1777885281
2013	1788014373
2014	1792080746
2015	1814008706
2016	1852807740
2017	1894073724
2018	1937384039
2019	1955133668
2020	1941232721

It can be seen that the total forecast for mental health care treatment is rising as expected. The generalized model based on the results of the time series regression did not provided a meaningful result to predict the cost of mental health care treatment for OIF and OEF veterans. Investigating the results given on Tables 4 and

6, the constant coefficient has a very large value indicating that more variables are not being accounted for. This is also apparent with the R-squared and Adjusted R-Squared values. The OIF coefficient is small as compared to the rest of the variables that its effect in the model is minimal. The p-value is also large, such that this variable is not statistically different from zero. In fact, almost all of variables except for the constant, AR term, and VW fall into this same category. This is not too surprising given the lack of observations from OIF/OEF. As mentioned at the beginning of this paper, data limitations severely restricted the analytical tools that we could bring to bear on this problem. Notwithstanding the fact that most of the variables are statistically insignificant, we are loathe to drop variables that have theoretical basis for inclusion. A sensitivity analysis was conducted to check the magnitude on difference of cost with a 5% and 8% increase number of patients.

Table 7. Sensitivity Analysis Table

Year	5% Increase	8% Increase
2006	1,291,380,451	1,082,876,550
2007	1,308,612,684	1,037,198,262
2008	1,288,774,760	997,667,901
2009	1,249,949,563	951,849,509
2010	1,262,541,885	962,972,282
2011	1,262,279,444	962,233,426
2012	1,278,194,202	978,382,807
2013	1,288,939,368	989,497,985
2014	1,293,011,140	993,570,456
2015	1,315,975,521	1,017,152,069
2016	1,356,619,286	1,058,901,467
2017	1,400,073,806	1,103,668,323
2018	1,445,433,496	1,150,257,748
2019	1,464,189,504	1,169,617,804
2020	1,449,629,539	1,154,661,975

It can be noted that the total cost are decreasing with an increasing number of psychiatric patients. The total annual cost for psychiatric treatment is greatly affected by VW and OIF/OEF negative coefficients. Given the paucity of the data, we are unable to accurately forecast mental health care cost for OIF/OEF. What we can forecast are the costs associated with mental health care cost as caused by exposure to combat, as we have above. We will need to leave the OIF and OEF forecast for future research, when data becomes more readily available.

Chapter 5

Summary and Conclusion

This research provided a model that captured a general overview of the total cost for psychiatric treatment in the VA for Fiscal Year 2006 to 2020. However, it failed to predict the cost for mental health care cost associated with the OIF and OEF veterans. A more robust statistical process and larger data set is needed to enable a better forecast. However, the model overall captured the general trend of increasing cost of psychiatric treatment as supported by majority of the literatures and journals. For example, the number of patients who received specialized mental health care rose 35% between 1995 and 2001 (Chen et al., 2003:256).

With the increasing operations tempo and continued war against terrorism, many more military members will be deployed to hostile areas such as Iraq. Initial signs imply that these ongoing wars are likely to produce a new generation of veterans with chronic mental health problems associated with participation in combat (Litz, National Center for PTSD VA: 2006). Accounting for this fact, it should be expected that the coefficients for OIF and OEF should be positively correlated.

Critically reviewing the regression results, many of the important variables were not statistically significant, with coefficient signs that run counter to individual studies reviewed earlier. Much of this may be explained by factors not considered in those earlier studies. Some possible explanations include the changing definition of mental illness, the fact that these studies were conducted by different researchers, etc. As expected, hardest obstacle in completing this research was data availability.

Data limitations have greatly restricted the robustness of the models created and the type of methodologies that can be utilized. Nonetheless, a general forecast of the cost for psychiatric treatment for all of the veterans within the VA Treatment Facilities has been established.

There are further studies that can be done within this area. A follow-up of this study using a more rigorous statistical process and larger dataset will greatly enhanced the actual model. The result might have a significant impact concerning budgetary appropriations for mental health care within the VA. Another interesting topic to pursue is finding out if there is a relationship between utilization of psychiatric treatment and disability payments. This will help the Veterans Affairs to allocate their resources better and implement rigorous policies for disability compensation.

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14. ABSTRACT

The war in Iraq has been the longest sustained ground combat that the US military has engaged since the Vietnam War. With the ongoing battle against the global war on terrorism, many military personnel will be deployed to hostile areas in support of these operations. The effects of multiple deployment and combat engagement on the mental health of military personnel have been extensively studied. The impacts of mental illnesses, such as PTSD, are tied to longer period in the combat zone. Meeting the psychiatric needs of these veterans will be costly: rehabilitation, retraining, post combat counseling, long-term medical treatment, and even assisted living. This study attempts to predict the cost of mental healthcare for the OIF and OEF veterans. However, we failed to accomplish a forecast for the cost of psychiatric treatment for those veteran populations due to data limitations. This study will not only give a general forecast for mental health care cost in the Veterans Affairs Healthcare System, but as well as explain any correlations between the various independent variables and mental health care costs. The data were compiled from various government documents and medical journals. Information received from VA Office of Policy, Planning and Preparedness was extensively used in this study.

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